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# SCIENCE

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## THE STUDY OF EARTH MOVEMENTS IN CALIFORNIA[1]

IT has been the custom for a number of years for the retiring president to present in brief review a field of activity with which he has been associated rather than to undertake the detailed exploitation of any particular problem. I have therefore chosen to give some outline of an effort which has been in progress for four or five years only, but which is particularly appropriate to present in this time and place because there are so many in Washington who have been associated with it.

The present study of earth movements in California is planned to be of broader scope than a mere statistical study of earthquakes. It is intended to do somewhat more than record tremors with the seismograph, in order, by comparison with other similar records, to trace the path of the waves to a common center of disturbance, and so to obtain information about the manner of their transmission through the interior of the earth. This is a part of the project as heretofore, but we have wished to investigate not only the tremors which may be picked up here or there and their path traced to a distant point of origin, but their probable causes, the earth movements at the source, cumulative mass movements through which the enormous strains are set up and not alone the disturbances which indicate their release.

The particular project, out of which the present undertaking grew, started with Mr. Harry O. Wood, known to many of you as acting secretary of the Geophysical Union, following the war period; before that as the assistant in charge of the Seismological Station at the Kilauea Observatory, where he successfully recorded and analyzed local shocks of volcanic origin; before that as an assistant to Professor Lawson, at the University of California, and one of the collaborators in the preparation of the great monograph on the San Francisco earthquake of 1906. Guided by this experience, Wood prepared and published in the *Bulletin* of the Seismological Society a very elaborate project for the study of cumulative stresses and local earth movements in California on an extensive scale. Some of you may have read the scheme which he offered. It contemplated stations at intervals of 50 miles throughout the West Coast region and continuous observations over a period of years. Altogether, it was rather too extensive a project for any available agency and so after

[1] Address of the president of the Washington Academy of Sciences, January 13, 1925.

the matter had been considered by several interested institutions it was laid on the table, so to speak.

It is due to President Merriam, of the Carnegie Institution, that an actual beginning was made in this field of activity. He said, very practically, that while we might not, perhaps, undertake a two-million-dollar project for the study of earthquakes, it was certainly true that California offered a favorable field for such studies and America was not doing her share in the field of seismology. It was therefore desirable that a beginning be made. In consequence of this view President Merriam in 1921 appointed a committee, designated as the advisory committee in seismology, to formulate a plan whereby the Carnegie Institution might effectively enter the field of seismologic research, perhaps along the lines indicated by Wood, but in any event with a somewhat broader concept of the field than has been usual among existing agencies. This committee prepared such a project some four years ago and offered it to the president and trustees of the institution for their consideration. Then the thing happened which sometimes does happen, despite all expectations—the committee, having allowed its collective imagination to revel somewhat irresponsibly in the new field, was sharply recalled to realities and invited to put its plan into operation. That is how the advisory committee in seismology was called into existence and presently became an executive committee, entrusted with carrying out a rather comprehensive project for the study of earth movements in California.

The first definite step which was taken was an incidental result of Professor Lawson's examination of a long series of position observations which had been gathered over a period of years at the Ukiah latitude station. In 1921 Lawson published a paper embodying these data and drew from them the conclusion that there was evidence of a nearly continuous northward crustal creep in the San Francisco Bay region amounting to as much as a foot a year for some 20 years. Confirmation was immediately sought on all sides and first of all naturally at the Lick Observatory on Mt. Hamilton. The Lick Observatory is not a latitude station, nor indeed a station where position observations are regularly made, but it was in the same region and had many observations from which determinations of position might be computed. Consequently, at the request of the committee, the Lick Observatory examined its records over the period of time covered by the latitude measurements at Ukiah. In general these were reported to confirm the Ukiah observations.

Now in the theory which had been worked out in beautiful detail by Reid, of Johns Hopkins, and published in Lawson's memoir on the 1906 earthquake, the conclusion was reached that the elastic rebound from cumulative strain carried to the point of rupture was the earthquake and that our most fundamental step in the study of seismologic activity, that is, of earthquakes, lay in finding the direction and magnitude of the forces indicated by the accumulating creep. Both Lawson and Reid had therefore been following that trail since 1906, perhaps even longer than that, and this publication of the records of the observations at Ukiah, presenting as it did the first step of tangible accomplishment in that direction, attracted wide attention. It was, however, not immediately acceptable in this form, that is to say, it could not command final acceptance on the basis of these figures alone, as Lambert, of the Coast Survey, was quick to point out. His analysis of the observations showed quite plainly that the residuals which indicated continuous movement northward were of the same or a smaller magnitude than the errors in the observations themselves, and so, while they might offer promising evidence of continuous creep in the direction suggested by Lawson, unless other support could be found they were not in themselves conclusive evidence of such a northward movement. Accustomed by tradition to the highest standards of precision and thoroughly familiar with the treatment of such data the scientists of the Coast Survey indicated very clearly that such a conclusion could be true only when certain assumptions were made regarding the distribution of errors in the corresponding records from stations in Italy and Japan, where like observations were taken, and these assumptions appeared entirely arbitrary. Where the precision of the astronomical observations is limited to something of the order of a meter distance on the ground and other disturbing causes beside crustal creep are within the range of possibility, a continuous crustal displacement of a foot a year becomes a somewhat precarious conclusion, and I think from the time of the publication of Lambert's paper it has been generally admitted that the conclusion requires further proof.

Quite naturally those who had been startled by the sudden apparition of a crustal creep of a foot a year along a thickly populated section of the California coast region immediately pressed their inquiry whether or not some other agency beside the astronomers might not return a more positive answer to the somewhat disturbing question which had been raised, and so we consulted the Coast and Geodetic Survey regarding the possibility of checking up the primary surveys through which all our landmarks and boundaries are controlled. Primary triangulations had been made in California at three different periods, one early, one in the seventies and one after the earthquake of 1906, and these, if the available bench marks

happened to be fortunately placed, should contain conclusive evidence of a continuous crustal movement as great as a foot a year. It appeared upon examination that the last of the surveys (1907), and the only one falling actually within the period of the Ukiah observations, had to do mainly with the displacement which accompanied the San Francisco earthquake of 1906. There you will remember we had an apparent north and south movement, respectively, on the two sides of the San Andreas fault, with practically no vertical movement whatever. This displacement amounted to as much as 20 feet in various places and the crack along which the displacement occurred could be traced for 190 miles. The reoccupation by the Coast Survey in 1907 of the stations on either side of the fault yielded measures of relative movement along the fault; it did not yield a true record of the absolute movement nor a conclusive answer to our question for a reason which was not noticed at the time when the survey was made. The base line to which those observations (of 1907) were referred was itself within the disturbed region. The pair of hills forming the Mocho-Diablo base line lay exactly between Ukiah and Mt. Hamilton, and if these two observatories were moving northward at the rate of one foot a year obviously the base line of 1907 was moving also. Accordingly, it became necessary to make a further effort not only to ascertain just what movement occurred in 1906, if that should still be possible, but to establish suitable bases for the determination of future displacements in this region which should not be subject to these uncertain limitations. The chief of the geodetic division of the Survey, Dr. Bowie, became interested in the problem and after some consideration a definite plan was made which received the support of the California delegation in Congress and an appropriation of $15,000 was made for the specific purpose of establishing positions in this region. Whether for the study of drift or tremors it was plainly first of all necessary to lay a network of precise triangulation over the region through which movements could be established beyond all doubt. Three seasons of this work have now been completed. It was sought first to establish points in the San Francisco Bay region, and in particular this Mocho-Diablo line, by reference to a more stable region farther back from the coast. Upon the advice of the geologists it was deemed sufficient to go back to Mts. Lola and Round Top, near Reno, for that purpose, and so the survey began at those points and a double set of triangles was measured to San Francisco Bay and thence southward. It was found at once that when referred to these fixed points (Lola and Round Top) the Mocho-Diablo line had moved from four to five feet to the south since the earlier surveys, so that although the direction of apparent movement did not coincide with the movement indicated by the astronomical observations, nevertheless the base line was quite untrustworthy as a permanent reference base for such a study as the one in hand.

The survey was continued in the second season from Mt. Hamilton southward as far as Santa Barbara Channel, where the work was temporarily interrupted by fogs and the surveying party was transferred to the Mexican Boundary whence it worked northward, leaving a gap at the close of last season amounting to about 50 miles. This season has witnessed the completion of the survey along the coast and its extension eastward so as to tie into the Colorado River Basin, the most stable region known in this part of the country. The northern end is therefore tied fast with Mts. Lola and Round Top, the southern end with the Colorado River Valley. The observations will be continued during this winter northward to include Ukiah.

Now I think it safe to assume that this set of triangles as now established will serve to define accurately in direction and magnitude any surface displacement likely to occur in the region under discussion, that is, from Point Arena southward to the Mexican Boundary, including all the territory to the west of the Sierra Nevada Mountains. Already it has established the fact that the Mocho-Diablo base line of 1907 is within the zone of movement; indeed, it has done much more than this, it has shown that there is general movement southward on the east side of the San Andreas fault and movement northward on the west side; that the movement on the west side of the fault is much greater than on the east side, amounting in the extreme case to 24 feet (northward) and, more astonishing still, this maximum movement is not within the region of the slip on the fault plane in 1906 (the great earthquake) but to the south of any movement then recorded. Nevertheless, it coincides in direction (northward) with the earthquake displacement of the disturbed region on the same side of the fault lying to the north of it. This is a revelation of the greatest importance and interest which is not yet fully elucidated.

Perhaps before proceeding to the elaboration of further plans for the study of these local movements I ought to say that of course it is one thing to establish the surface relations, that is, the means whereby movements either of accumulating strain or sudden release will be located, it is equally important to know the sub-surface relations, that is, the geology, and there this committee has enjoyed the cordial and effective cooperation of the two universities of California and the U. S. Geological Survey. From the Survey Messrs. L. S. Noble and W. S. W. Kew have

allotted a considerable part of their time to the detailed geology of the southern region along the San Andreas fault. That cooperation has been invaluable, though I can not give you very specific information in regard to it in advance of publication, except such as is contained in the Fault Map of California, lately published by the Seismological Society of America. Mr. Noble has reported the progress of his work each year and presently the Geological Survey will publish it. It has already served to locate the active faults in the southern part of the state, which are believed to be associated with the great San Andreas fault in the north.

It is an especial pleasure to speak of the interest which has been aroused by this work and the freedom with which most competent cooperation has been offered. Last summer while in California I was told by Professor Tolman, of Stanford University, that his entire class had been sent into the field with the San Andreas fault as their summer problem. The University of California has given like cooperation in the region north of San Francisco Bay. It is interesting also and of the greatest importance, while we are speaking of the cooperation which we have everywhere enjoyed, that the Navy Department, when it became known that these faults were being traced on the land and that the displacements expected were considerable, very kindly undertook a survey of the ocean floor to the west of the region which we were studying in order to trace the extension of these known zones of structural weakness beyond the coast line. It happened that the Navy Department had available a sonic sounding device developed during the war. Two of these were mounted upon the destroyers *Hull* and *Corry* and about 30,000 soundings made, extending out from the coast line to 2,000 fathoms depth. That was as deep as it was deemed worth while to go at that time. The Hydrographic Office has since compiled and published a chart from these soundings which is known to many of you. It has now been published for nearly a year, and is the first attempt to prepare a detailed contour map of any considerable area of the ocean floor.

While I am speaking of the Hayes sonic sounder and its use, it is important to add that last summer one of these sounders was placed on the Coast Survey vessel *Guide,* in charge of Commander Heck, for the purpose of ascertaining accurately the limitations of the instrument and the constants upon which its precision depends. It had been estimated by the Hydrographic Office that the soundings of the first survey were accurate to about 5 per cent. On the *Guide* it was found possible to reach an accuracy of 1 per cent. by making proper corrections for the temperature and pressure of the water in which the soundings were made. Indeed, it is now possible to make depth determinations with this sounding device with as much or perhaps even more accuracy than the positions at sea can be determined, for position determinations beyond sight of fixed land marks are rarely closer than a mile. It is necessary for us to consider these two measurements side by side and to recognize that the sounding is only valuable in proportion to the precision of the position measurement which we can associate with it. That also is a problem which is now being studied by the Coast Survey with the same care which characterizes all its activities.

This contour map of the ocean floor was first printed as a chart by the Navy Department, as I have already mentioned; afterward, with the permission of the Chief Hydrographer, Captain F. B. Bassett, it was associated with the land-fault map and reprinted by the Seismological Society of America in March of last year. This map is now available for distribution at the office of the Seismological Society of America, at Stanford University, and represents one of the very considerable forward steps which have resulted from the cooperative activity which I am privileged to describe to you to-night.

These steps, as I have outlined them, will have given you a reasonably tangible account of the efforts which have been made, first to discover and map the zones of structural weakness, and second to prepare the landmarks through which to establish the direction and magnitude of future movements whenever they may occur there. It is particularly our purpose to learn something of the accumulating stresses, the creeps, if you like, from which eventually the earthquakes come. I think few of us who have studied this question at all can have any other idea in our minds than that an earthquake is a release of accumulated stresses which have strained parts of the structure beyond the elastic limit. If we approach the structure as engineers, we neither violate nor lose sight of any principle of geologic analysis. We may examine it as we would a steel structure, inquire into its age, its distribution of temperature, its loading, we may examine its joints, and its vibrations; indeed, there is an established routine for such examinations.

If we examine any considerable section of the west coast region as a structure we shall perhaps first recognize the fact that it is very badly loaded. Not far from the coast line and parallel to it lies the highest mountain range within our territory, the Sierra Nevada, with peaks rising more than 14,000 feet above sea level; a few miles out to sea the continent breaks off at the "continental shelf" to a depth of 12,000 feet or more below sea level—also approximately parallel to the coast line. Between these two there is a structure subject to this difference in load

amounting to more than five miles of rock. It is surely not surprising that great faults are found between these two features and parallel to them.

Also we have in California regions of very great temperature disturbances. There are hot springs in great number and many areas where the temperature of boiling water is reached but a few feet below the surface. These are regions of movement and of local instability. There are also anomalies in gravity here greater than are found elsewhere in this country, indicating perhaps that recent geological erosion has also contributed to the inequality in the loading. All these things point to the factors which will enter into any analysis of this problem considered as a study of structures subject to strain. Now if the structure is to be studied thoroughly and competently, it is not enough merely to have laid a network of absolute measurement over it to detect displacements, neither is it enough to have mapped exposures indicating the geologic sequence of strata. We must also do what we can to ascertain the effect upon this composite system, of variations in the dynamic relations involved. If it be true that the earthquake represents a major or minor rupture under local overload, then we must study the tremors in this structure as we would in any other, to locate the point of weakness. This, in our case, is not at all a question of securing a record of all those major tremors which affect the earth as a whole, that is to say, those which are as readily detected in Washington or Berlin, Italy or Japan, but rather the minor local tremors of short-wave length and 50 or 75 mile range, which carry the evidence of incipient break-down or perhaps of creep. Such tremors are common in California but have been little studied. Indeed, we have had no instrument which was properly sensitive to these short waves heretofore. And so one of the foremost tasks which this committee set for itself was to secure the design of a seismograph which would record these short-period local shocks—the same class of shocks, by the way, to the study of which Wood's original project was mainly directed. Wood, J. A. Anderson, of Mt. Wilson Observatory; Frank Wenner, of the Bureau of Standards, and Arnold Romberg, then connected with the Kilauea Seismologic Station, were brought together in Pasadena for conference. Out of this conference came a design for a vertical component instrument of Galitzin type with a period of two seconds which promises well but is not yet completed.

Independently of this development Dr. Anderson, with the cooperation of Mr. Wood, contrived a wholly different type of instrument, based upon the torsion principle, which I have already had the privilege of describing within the hearing of many of those here present. With this instrument, of which one component (NS) was set up at Mount Wilson Laboratory and one component (EW) at the California Institute of Technology in 1923, more than one hundred local earthquakes were recorded in the first six months.

Anderson, brought with him the latest model of this instrument for the annual exhibit of the Carnegie Institution of Washington in December and it has been placed here for your inspection. Without going into descriptive details which have already been printed in the *Journal* of the Optical Society of America, the instrument has this advantage over any seismograph yet developed in that it may be readily tuned to be sensitive to any period likely to be encountered. The two instruments set up in Pasadena were arranged to operate with a free period of 0.8 of a second and a static magnification of about 1,200. The instrument before you has a like period and a magnification of something over 4,000. Without other changes than those of adjustment and the substitution of a somewhat differently distributed mass, the same instrument has also been used with a period of 15 seconds and low magnification corresponding with the teleseismic instruments in common use. In view of the interest of the Coast Survey in a teleseismic instrument, one of these seismographs, with a free period of 15 seconds and a magnification of about 300, was placed in continuous service in Pasadena a year ago. Its records were most satisfactory.

In theory and in practice, in adjustment and in adaptability to all purposes, this instrument is extremely simple, is as portable as a galvanometer and for the purposes of this investigation promises to be most effective.

The original instruments have now been in use about two years. The only additions so far made have been: (1) Provision for adjusting the magnet up or down with reference to the steady mass, in order to provide overdamping, critical damping or any desired fraction of the latter; (2) a foot-screw several inches in front of the suspension in order to provide either accurate vertical adjustment of the suspension or a measured departure from the vertical as may be desired; (3) a mirror was substituted for the lens in the path of the light beam in order to double the magnification by means of a second reflection from the moving mirror. It is now possible to obtain a static magnification of four or five thousand. One limitation has developed in the seismograph. In case of a considerable earthquake, with an instrument of high magnification recording photographically, a very wide and rapid excursion of the ray of light is to be expected and its trace, in consequence, will be somewhat faint. An extremely intense source of light was therefore employed, and reduced to about one fifth of its normal intensity by

a rotating sector. The record then consists of strong dots which, for normal recording, form a continuous line, for a strong earthquake a discontinuous but well-defined curve. This arrangement has served the present purpose satisfactorily, but a simpler device may be found to accomplish the same purpose. I hope those of you who are interested will take the trouble to examine this instrument. It is proposed to equip a number of stations with them during the present year.

This plan of primary triangulation, then, has given us a control upon surface displacements which I think has never been surpassed before in any region of equal extent. The geological study of the region and the submarine soundings have given us much information regarding its structural weaknesses (faults). Now by the use of this instrument we cherish the possibility of establishing the sources of tremors and the direction of their path along and across the zones of weakness. Already some opportunity has been found to test this mode of analysis. There have been two heavy discharges of explosive in California, one of 182 tons of dynamite, within about forty miles of Pasadena, and in both cases a very precise record was obtained. Nothing was known in advance about the first case, but in the second it was possible to obtain very accurate timing and an excellent measurement of the rate of transmission of the wave between the site of the blast and the recording instrument. It is therefore believed to be quite possible, by the use of these instruments, properly distributed, to locate the probable sources of most of the tremors in California, whether they originate near the surface, or, as we suspect in the case of the 1906 earthquake, the displacement had its origin at considerable depth.

It is in our minds also to determine tilt. Those of you who have followed the work of Professor Jaggar know that for a number of years he has been making careful observations of tilt on the flanks of the great volcano Mauna Loa and on the crater-rim of Kilauea, on the island of Hawaii, to see whether, from the variation in tilt, he can predict volcanic outbreaks. So far I think he has not altogether succeeded in that; or at least he has made use of other evidence in addition to tilt in the predictions he has made hitherto. Be that as it may, he has shown that tilt is definitely measurable. Now if the bulging of the mountain can be measured then obviously certain other kinds of "creep" can be measured, and it is definitely a part of our purpose to develop apparatus in California through which these slow, cumulative displacements may be determined both in direction and in magnitude in the same fashion as it has been possible to obtain a measure of the bulging of Mauna Loa in Hawaii. If we succeed in attaining that and have at our disposal competent laboratory determinations of the elastic limitations of the participating rock types, we shall presently be in a position to establish the degree of probability of release of such cumulative stresses by earthquake. I am speaking now of prediction in place rather than of prediction in time. It is not unlikely that prediction of the probable place of release of such strain can be undertaken with reasonable certainty in future. Prediction of the probable time of rupture involves factors which are not yet within our reach.

It is also a part of our purpose to measure internal pressures. It is not difficult to arrange an apparatus which will give a continuous record of deep-seated pressures which will also be of value in the elucidation of these structural relations.

If I have been successful at all I have outlined to you what is probably the most comprehensive plan that has yet been developed in the study of earth movements. It is characterized, more than anything else, by the effective cooperation between research organizations with widely different points of view. I have named the agencies, all well known to you, which are participating with us in this particular enterprise. The Coast Survey and the Hydrographic Office, approaching the problem from their respective viewpoints, have given us a trustworthy system of coordinates upon which displacements are to be plotted and relations shown; the Geological Survey and the universities of California have added the geology and subsurface relations; and finally the California Institute of Technology and two departments of the Carnegie Institution of Washington, Mt. Wilson Laboratory and the Geophysical Laboratory have aided in the development of appropriate apparatus, the establishment of stations, etc., in preparation for the systematic study of tremors. The trustees of the Carnegie Institution of Washington have set aside certain funds for the project, and the advisory committee in seismology has undertaken the administrative responsibility. Such a number of vigorous agencies, thus brought together, can not fail to accomplish a great deal more than any one could do alone; such a representative group of agencies, I believe, can not fail of success.

ARTHUR L. DAY

GEOPHYSICAL LABORATORY
WASHINGTON, D. C.

## THE SECOND GENERAL ASSEMBLY OF THE INTERNATIONAL GEOPHYSICAL UNION

THE second general assembly of the Union took place in Madrid, beginning October 1, in the build-

ing of the National Parliament. The king of Spain presided at the first meeting and the proceedings consisted of addresses of welcome. Then for a week the several sections met in different rooms and discussed matters of special interest to themselves. There are now thirty nations adhering to the Union, and nearly all were represented by delegates or by proxy. The United States had but four delegates, which made it impossible to keep in close touch with the discussions of the seven sections. At the final meeting on October 8th the several sections reported the results of their conferences to the general assembly.

The section of geodesy adopted the Hayford spheroid as the spheroid of reference for geodetic work, and it is hoped that it will be accepted by all nations. If all locations are referred to the same spheroid it will help greatly in connecting up the triangulations of the different countries. The principle of isostasy was discussed and accepted, and its application will improve the accuracy of the triangulations. The reduction of observations in accordance with this principle will probably be carried out in Washington. It was decided to make determinations of relative gravity between the base stations of the several countries so that the relative gravity at all stations may be properly compared. This is of great value for the determination of the figure of the earth and for studies of isostasy. A world net of longitudes is to be determined by radio; by carrying this net completely around the world systematic errors can be largely eliminated, and longitudes more accurately fixed. By repetition at a future date, any east-west movements of the continents can be measured. North-south movements can be determined from the observations at the latitude variation stations, three of which continued their observations throughout the war; the section of geodesy will assist, by appropriations in the reduction of these observations. Dr. F. A. V. Meinesz, of Holland, described a method of determining gravity at sea, by swinging pendulums in a submarine, sunk some thirty meters below the sea surface. The results of some observations in the Indian Ocean were very accordant and indicate a very close approach to isostatic equilibrium in that region.

In the seismological section the question of publishing annual lists of earthquakes was discussed, and it was decided, largely on account of lack of funds, not to undertake this for the present but Professor Turner will continue to issue the International Summary, which contains the records and locations of the more important shocks. It was decided that the transmission curve, which gives the time of transmission of earthquake waves from the origin to distant points, requires more study before an official curve could be adopted. Reports were made on the transmission of disturbances due to explosions, which travel more slowly than is indicated by the general transmission curve, due undoubtedly to the fact that they travel through the superficial part of the earth's crust. Reports were made on seismological work in Spain, which is being developed with much vigor; and on the work of the Carnegie Institution in California. The fault map of California and the diagrams of Anderson's new seismograph aroused much interest; also the account of De Quervain's large instrument which has been mounted at Zurich, and is giving satisfactory records of small shocks in the Alps. These instruments present a strong contrast; the former weighs a fraction of a gram, the latter twenty-one tons. The Japanese delegates gave interesting accounts of the great earthquake of 1923 before both the sections of seismology and of geodesy. The Central Bureau announced that it would begin the publications of seismological memoirs. The committee on that troublesome subject, microseisms, was continued.

The most important question discussed in the meteorological section was the project of compiling weather charts of the northern hemisphere for the third quarter of 1923. This is an important matter and could best be carried out by an international weather bureau. Some doubts were expressed as to the propriety of "placing money at the disposal of an existing state service for carrying on work of an international character in conjunction with a commission." Many other interesting questions were discussed: sampling air at great heights, measurement of relative brightness of ground and cloud, determination of the variations of the hydrogen content of the air, spectral measurements of solar radiation intensity, at Izana, Canary Isles, daily observations of temperature and pressure in the free air, observations of air-borne parasites, stations in mountainous districts and in the South Pacific, etc. The section recommended to the General Assembly the appointment of a committee to consider a simplification of the Gregorian calendar, and the recommendation was accepted.

In the section of terrestrial magnetism and atmospheric electricity reports were made of work accomplished in various countries. The section highly commended the work of the Carnegie Institution in the determination of the magnetic elements all over the world. It called attention to the importance of magnetic and electric observations in high latitudes, and recommended the west coast of Greenland, and Jan Mayen Island or Spitzbergen, as suitable locations for observations. Magnetic data from high latitudes

in years near sunspot maxima are very desirable. Observations to reduce atmospheric potential gradients to volts per meter over level ground are much needed. It is also most important to investigate the magnetic properties of rocks from all over the earth, and from different geological ages. An instrument to measure the vertical intensity of the earth's magnetic field in absolute measure is much to be desired.

The American proposal to approve explorations of the oceans was adopted by the section of hydrology and by the general assembly. Biological oceanographers have been admitted to this section.

The committee on glaciers, which was appointed by the International Geological Congress, has lapsed since the beginning of the war. The section of hydrology of the Union wishes to take up the problems of the variations of glaciers, and the Union made a small appropriation to enable Professor Mercanton, of Switzerland, to consult with members of this section and devise some means of continuing the records.

None of the American delegates was able to attend the meetings of the sections of vulcanology, oceanography or hydrology. This emphasizes the importance of making provision for at least one American delegate to each section at future meetings of the Union.

The arrangements for the entertainment of the delegates and their families were most elaborate. The king and queen of Spain received them at the royal palace; and the mayor of Madrid held a reception at the mayoralty. The reception committee (Sen. D. L. Cubillo, Chairman, Sen. D. J. Galbis, Secretary) were indefatigable in their efforts. Excursions were made to the most interesting places in the neighborhood of Madrid, including the city of Toledo, all at the expense of the committee; a concert was given at the opera house, the bull ring and the museums were thrown open; and the meetings closed with a banquet at the Hotel Ritz. I do not think such lavish hospitality could have been tendered in any other city of the world. After the meetings excursions were arranged to the cities of southern Spain and to the eastern coast; everywhere the hospitality was most generous.

The next general assembly of the Union will be held at Prague in 1927.

HARRY FIELDING REID
JOHNS HOPKINS UNIVERSITY

## IN MEMORIAM: SIR THOMAS CLIFFORD ALLBUTT
### (1836–1925)

SIR THOMAS CLIFFORD ALLBUTT, Regius Professor of Physic, in the University of Cambridge, died, during sleep, on the night of February 22, 1925, at the age of 88. He was born on July 20, 1836, at the vicarage of Dewsbury (Yorkshire), the last resting place of Robin Hood. His father, the Rev. Thomas Allbutt, was a clergyman of great influence in the West Riding and the author of various religious books. The son was educated at St. Peter's, York, and at Caius College, Cambridge (1855–60), where he held several scholarships and won the Natural Science Tripos, first class, in 1860. During 1859, he was the clinical clerk of the celebrated Bence Jones, of proteinuria fame, at St. George's Hospital (London), and, by his advice, followed the lectures of Trousseau at the Hôtel Dieu (1860), the clinics of Bazin at the St. Louis (dermatology) and of Duchenne in the Boulevard des capucins (neurology). In 1861 Allbutt was elected physician to the Leeds Fever Hospital, passing over to the Leeds Infirmary in 1864, and then successively to the Belgrave Hospital for Children (London), the King Edward VII Sanatorium (Midhurst) and the Addenbrookes Hospital (Cambridge). In 1892, he was appointed to the Regius professorship at Cambridge (established 1540), which post he held until his death.

The newspaper obituaries of Allbutt defined him as "an eminent British physicist," as he was the inventor of the short, self-registering, pocket clinical thermometer which came into vogue in 1868. Sir Clifford was, however, deeply read in modern physics, and this invention in particular was based upon his reading of Wunderlich's classic on temperature in disease (1868), which established clinical thermometry, and was based, in its turn, upon the thermodynamic principles which led William Thomson (Lord Kelvin) to establish an absolute scale of temperature for thermometry (1849). The earlier clinical thermometers were cumbersome contrivances, nearly a foot long, and were, in consequence, little used. Allbutt's invention made bedside thermometry a going concern. He was the first to describe the articular lesions in locomotor ataxia (1869), suppressed an epidemic of typhus fever by bold fresh air treatment, described the first case of Charcot's joint in England, as a member of the Alpine Club did much for the mountain cure of phthisis, and was instrumental, with the surgeon Wheelhouse, in introducing paracentesis of the pericardium (1866). His writings, which abound in subtle clinical minutiae, include his lectures on physical overstrain of the heart (1871), which was translated into German, on ophthalmascopy (1871), on auscultation of the esophagus (1875), the Goulstonian lectures on visceral neuroses (1884), the Lane lectures on heart disease (1896) and his two volume monograph on diseases of the arteries (1915). Following the tradition of Harvey, it was inevitable that English physicians should specialize

in the physiology and pathology of the circulation, and these volumes are a summation of Allbutt's vast knowledge, replete with historical allusions on every page. In the history of medicine, Allbutt was, in fact, the most distinguished modern English scholar. His books on "Science and Mediæval Thought" (1901), on the "Historical Relations of Medicine and Surgery" (St. Louis lectures, 1905), his Fitzpatrick lectures on Greco-Roman Medicine (1909–10) and his Finlayson lecture on Byzantine medicine (1913), both contained in the volume "Greek Medicine in Rome" (1921), are each of them masterpieces in the best sense of the term, the fruits of sound scholarship set forth in a literary manner of the most pregnant, stimulating and thought-compelling kind. His "Notes on the Composition of Scientific Papers" (1904) constitute a kind of text-book on the use of words and the art of writing which, with his tract on Professional Education (1906), have exerted wide influence. He was the editor of deservedly famous systems of medicine (1896–8, 2 ed., 1906–11) and gynecology (1896; 1906), and contributed the article on history of medicine to the Encyclopaedia Britannica (11 ed., 1911).

During a professional activity of some 65 years, Allbutt rendered distinguished public service on all sorts of committees and commissions, was vice-president of the Royal Society in 1914–16, and presided, with charm, at the celebration of Osler's seventieth birthday. His presidential address before the British Medical Association in 1920 will be long remembered for its large view of the future of scientific medicine.

In his lectures on Byzantine medicine, Allbutt, like Mommsen, views the Greeks as an intelligencia *in excelsis*, but without political talent, deifying the individual at the expense of the state. His own mind was of that cast, tending, as in his phrase about Galen, "to lose the universal in the particular." Reading Allbutt is like playing Bach or Brahms, an intellectual game requiring mental powers of the utmost refinement. In a series of "Letters to Eminent Persons," published in 1917, Allbutt is addressed as a happy combination of the essential scholar and man of the world, learned but cosmopolitan, urbane but detached and dignified, "the firm possessor of that subtle alembic something which the cognoscenti demand before they will concede the title of gentleman," yet ineffectual through this very refinement, which manifested itself, as in the case of Browning or Henry James, by "a slight tendency to prolixity."

> Nevertheless [the pseudonymous scribe goes on to say], this note of detachment has stood you in good stead. It has permitted you to "talk with crowds while keeping your virtue," and "walk with kings" without losing such of "the common touch" as it was in you to possess. It enabled you to be a Censor of the Royal College of Physicians without becoming in any degree soiled by the soot of snobbery which hangs like a pall over Pall Mall East, to concentrate, ever and anon, in comic negro-minstrelsy upon the Censors Board. They never made you their president, these paltry panjandrums, because they dared not. And they dared not because, being what you are, your large learning would have emphasized their mental mesquinerie; and being the gentleman that you are, you would have brought into pitiless prominence their puny, pretentious plebeianism.[1]

Allbutt was, in fact, the spiritual aristocrat in medicine, just as Osler was an essential democrat in professional relations, gregarious and fond enough of people to be sometimes victimized by them. Neither of these high-souled gentlemen were politicians, *i.e.*, wheedlers and victimizers of their fellowmen. Allbutt's aloofness was that of the scholar lost in his subject, as shown by his lively sympathy with such American traits as the Chicago placard for infant welfare, "Give the Baby a Square Deal!" Judging by a correspondence of some fifteen years, I have never known a kindlier, serener soul. His first letter to me was a spontaneous illuminating criticism of an amateurish maiden effort on the terminology of disease, so encouraging and *eingehend* that I at once ransacked the literature for his articles on the subject. On this terrain he was unrivalled, his only possible competitor being William Farr, whose classification of diseases was adopted by Billings and Fletcher in the Index Medicus. Leaving Allbutt's work on internal medicine to the experts and his historical writings to the inevitable delight of all cultivated physicians, a few words on his three essays on classification (1867, 1888, 1906) may not be amiss. They are *Zukunftsmusik* of an aspiration so exalted as to be, in mathematical phrase, asymptotic; wonderful visions into the medicine of the future which it will require post-bellum medicine (visibly "limping across the state line") many decades to realize. We are to classify diseases of men, animals and plants on a scheme of comparative nosology based simultaneously upon their hereditary, historical and geographical relations and upon the findings of experimental medicine, a polyphonic method suggesting Ousspensky's Tertium Organum. Yet Allbutt is keenly aware that the data for such an orchestration of thought are, as yet, only scattered and fragmentary.

> Gout and cancer are autogenous, smallpox and ague extraneous in origin; in phthisis, the extraneous cause is a touchstone of diathesis. All diseases of modern peoples become neurotic in type, as Cullen surmised. Changes in types of disease are due to this fact and to the racial (*i.e.*, chemical or metabolic) complexion of peoples.

[1] Med. Press. and Circ., Lond., 1917, CIII, 199.

Diseases must be studied in family trees. There are even pathological races of people, set off by atavism. Each disease is only a member or term of a series—*e.g.*, the rheumatic series (purpura, urticaria, pemphigus, erythema, endocarditis, chorea, arthritis), or the gouty series (dyspepsia, arthritis, phlebitis, arteritis, nephritis, angina pectoris, migraine, hypochondria, insanity, eczema, glycosuria, neuritis, bronchitis, tonsillitis, haemorrhoids, purpura). Fever is a thermo-ataxia. Gout implies the metabolism of a bird. Infection and immunity are analogues of impregnation and sterility in sexual congress. Each locality or race has diseases peculiar to it. Each tropical country has its own kind of tropical medicine. Malarial fever in a locality usually connotes infrequency of cancer, typhoid, phthisis, insanity (neurosyphilis) and epilepsy. Poisons of active principle (acid) type produce hyperthermy, poisons of alkaloidal (basic) type hypothermy. Curare turns a mammal into a cold blooded animal. Poisoning and dextoxication turn upon isomerisms and molecular vibrations.

That all this was written over 35 years ago is a measure of the splendid scientific scholarship of Allbutt. Alas! that medical literature should be a motley proliferation of the well-born, the plebeian, the upstart and the bounder; that Starling's classification of physiology should tuck titles into wonderfully considered compartments where only Starling can find them;[2] and that we must still stick to the old caravansary plan of Billings and Fletcher, with suites, bedrooms and cubby-holes for all and sundry. By 1906, Allbutt himself had come around to this view: "The best labels for diseases are such names as epilepsy, measles, leprosy, Graves's disease and the like, which, having no attachment to hypotheses, are readily carried to new anchorages."

Three mental traits distinguished Allbutt: an innate and almost touching modesty, a fitting reverence for the past, the liveliest sympathy with the present and the future. His Finlayson Memorial Lecture begins: "I would that my lecture to-day were more worthy of him." His Harveian Oration concludes: "We celebrate the memory of great men in the certain hope that in their children they will be born again." His message to the future is that the wars and squabbles of mankind are due to mistaking the names and labels (personal opinions) of things for the things themselves, and that "almost any reform is possible so long as names are not touched." Our rough-neck post-bellum world will not find his match in noblesse of mind and nobility of character.

F. H. GARRISON

ARMY MEDICAL MUSEUM

[2] International Catalogue of Scientific Literature, Schedule of Classification, Q.

# SCIENTIFIC EVENTS

## JOHN FILLMORE HAYFORD

THE following minute has been adopted by the Chaos Club of Chicago:

In the passing of John Fillmore Hayford on the tenth of March, 1925, the Chaos Club has lost an esteemed member, a genial and friendly companion, an earnest devotee of research, a productive scholar.

Professor Hayford's training as a civil engineer prepared him directly for his life work which he found in the field of geodesy. His high regard for accuracy, his fine sense of good method in assembling and discussing data, his unlimited perseverance in pursuing a problem, his experience in field work, equipped him in an eminent degree for the enormous task of fitting an ellipsoid to the surface of the earth. Recognition is now given to the success of this work in the adoption of the Hayford ellipsoid by the Geophysical Union at the recent meetings in Madrid. It will now serve as the basis of reference for all the great national surveys.

Perhaps no less important than his determination of the size and figure of the earth is his work on isostatic compensation within its surface. His careful discussion of available data led to the substantiation and acceptance of the principle of isostasy.

Aside from his great service in the Coast and Geodetic Survey, he devoted his labors to engineering education. He was an instructor in civil engineering at Cornell University from 1895 to 1898, and in 1909 he came to Northwestern University as director of the newly organized School of Engineering. His clear conception of the proper relation of his profession to society and his keen appreciation of the value of research work, his own indefatigable labor were conspicuous qualifications for such an appointment.

While at Northwestern University he had devoted himself to the very difficult problem of the surface levels of the Great Lakes, the source of supply, evaporation, periodic fluctuations, effect of winds and barometric pressure, seiches. Reports have been made on some phases of this very intricate problem, but unfortunately it remains unfinished.

Professor Hayford's counsel was in demand in various fields of engineering; he served on a commission to determine the boundary between Panama and Costa Rica; he was a member of the National Advisory Committee for Aeronautics; he was greatly interested in the Society for the Promotion of Engineering Education; he was an author of valuable text-books; his voice was heard in many geodetic conferences. He was scholarly by every instinct and according to every standard of measurement, and of his students demanded the like. He was a valuable citizen, giving loyal, enthusiastic and unsparing service to his government in peace and in war, to the community, and to society.

The members of the Chaos Club wish to express their feeling of deep loss and to extend their sympathy to Mrs. Hayford and the other members of Professor Hayford's family.

## THE EASTERN NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY

DR. MARTIN H. FISCHER, of the General Hospital of Cincinnati, addressed the regular meeting of the Eastern New York Section of the American Chemical Society, held in the research laboratory of the General Electric Company at Schenectady on March 14. His subject was "Lyophilic colloids in theory and in practice." Following his lecture in Schenectady, he spoke in Albany before the Medical College of that city on "Nephritis and oedema."

Dr. Fischer's theory, offered in place of the osmotic pressure theory to account for the life absorption processes taking place within the lining organism, brought forth lively discussion. His manner of presenting his arguments, livened by frequent references to the osmotic theory, which served as interludes in the serious nature of his talk, kept his audience at strict attention. And in conclusion, his very simple demonstrations of the alkalinity of some of the strongest acids when in concentrated form, clinched his arguments and brought his lecture to a very successful conclusion. His many demonstrations, in fact, were a strictly integral part of his lecture.

On Tuesday, March 31, at the Rensselaer Polytechnic Institute, in Troy, Dr. Zay Jeffries will address the Eastern New York Section on "Aluminium." This is an appropriate topic for such a speaker, in view of his connection with the Aluminium Company of America. The policy of scheduling lectures of more general interest on week nights, with the highly scientific lectures on Saturday morning at the General Electric Company, has resulted in an increase in the attendance at both varieties of lectures, since the members and their guests now know the nature of the lecture scheduled. This radical change in the policy of the section has proved its worth also in another direction. T. A. Wilson, the secretary of the section, reports a greatly increased enrollment of associate members, since both classes of audiences are appealed to, and a noticeable increase in the full-member enrollment has resulted because of the appeal to the scientific membership of the community.

Dr. Charles A. Kraus, of Brown University, will be the speaker at the meeting to be held at Schenectady on Saturday, April 4. His subject will be "The amphoteric nature of the elements."

## THE NATIONAL INSTITUTE FOR RESEARCH IN COLLOID CHEMISTRY

*(From a correspondent)*

OF all the proposed plans for intensive research yet formulated in this country, probably none has been received with more enthusiasm than has the plan formulated by the Committee on the Chemistry of Colloids of the National Research Council for a National Institute for Research in Colloid Chemistry. It is now generally realized by scientific men that a knowledge of this phase of chemistry is absolutely essential to the development of medicine, the biological sciences, agriculture and many industries. The demand for men trained in colloid chemistry is growing at a rapid rate and this demand is not now being met because of the lack of training facilities and research centers devoted to the study of this subject in America.

The Colloid Committee of the National Research Council has worked out in great detail a plan for an institute devoted to intensive study in this field. This institute will serve several useful purposes. A strong research center of this kind will serve as a stimulus to all workers in the field, wherever they may be. The knowledge that the facilities provided at the institute will be available to any qualified worker, and that the cooperation of the staff may be had for the asking will have a most beneficial effect on all colloid workers.

The institute will serve as a training school for research workers and the men so trained will supply the demand for teachers and research workers elsewhere. No existing agency can possibly give the intensive and thorough training that such an institute can give. The plan contemplates that from twenty-five to forty men will constantly be in training to meet the demands of the universities and the industries.

The institute will be to the colloid workers of the country what Woods Hole is to those working in the biological sciences—a place where intensive study may be combined with healthful recreation in the summer months. Special apparatus will be available at all times to properly qualified research men, and particularly for the benefit of those who desire to avail themselves of the facilities of the institute for short periods of time, either in the summer or during the year, it is planned that a number of rooms will be fitted up with special equipment, always complete to the last detail, so that one coming to the institute will be able to begin work on his problem at once. Much valuable time will thus be saved, and more progress will be made.

During the summer season, at which time workers from other institutions will be most likely to attend, there will be special lectures given by recognized leaders in colloid chemistry. Three or four specialists in different fields of colloid chemistry will be brought to the institute each summer to give special lectures and to supervise research in their chosen fields. These special lectures will be of such character as to

attract men from fields other than pure chemistry, the purpose being to emphasize the application of colloid chemistry to all branches of science.

The institute is to have a director of research and a laboratory or business director. The research director will have a competent staff of assistants and associates so that several fields of colloid chemistry will be represented. The business director will attend to business details, thus leaving the time of the research director free for scientific work. Funds will be provided for a number of fellowships. Some of these will be for men who have received the doctorate degree, and others for graduate students who are working for that degree.

It is planned that the institute will be located at and operated in conjunction with one of the major universities where there already exists a proper scientific atmosphere, and where full cooperation between scientific departments and the institute will be assured.

The institute will be housed in a building specially constructed with the needs of colloid research in mind. The building will have some unique features not ordinarily found in chemistry buildings. In addition to offices, private laboratories, library, conference rooms, instrument shops, etc., it will have an abundance of special laboratories equipped for specialized studies, also rooms in which work of a more general character may be done.

To build such a building as the committee has in mind and to provide an endowment, the income from which will be used for operating expenses, a sum of about $1,250,000 will be necessary. It is expected that the cooperating university will furnish the site for the building and a fund of approximately $50,000 a year for maintenance, service, et cetera. The work of the fellows working for degrees will be credited in the graduate school of the cooperating university.

The plan has not only the endorsement but the active support of the National Research Council. It has also been approved by the National Academy of Sciences, the Council of the American Chemical Society, the Council of the American Institute of Chemical Engineers, and a very large number of scientists throughout the country.

The Committee for the Chemistry of Colloids feels that in this plan it has an opportunity for practical philanthropy which is second to none at the present time. It is hoped that funds will soon be forthcoming to make this far-sighted plan an actuality.

The University of Wisconsin, because of its interest in Colloid Chemistry, has issued an attractive prospectus in behalf of the proposed institute, the publication of which was erroneously credited in a recent issue of this journal to New York University.

## SIGMA XI AID TO RESEARCH

SIGMA XI Alumni have made available a sum of money to be used annually in the support of research. For the year 1925–26, the sum of $2,000 will be awarded by a special committee consisting of Dr. W. R. Whitney, director of research at the General Electric Company; Professor E. L. Thorndike, of Columbia University, and Dr. John H. Northrup, of the Rockefeller Institute for Medical Research. This fund will be granted by the committee to selected workers who have shown devotion to science and who merit assistance in further research work. The aid granted will not be limited to any particular field of work, nor will it take any particular form. It may be awarded in the form of a fellowship or it may be given to purchase apparatus, to help in publication or to pay assistants.

Applications for aid from this fund should be made before May 1 to Dean Edward Ellery, Union College, Schenectady, N. Y. Applications should state the kind of assistance desired, the nature of the problem under study, or to be studied, and the place where the research is being done or is to be done. Applicants should present their educational and research experience, degrees received and titles of publications. There should also be a statement regarding the importance of the problem in his particular field from at least two individuals competent to express judgment.

Awards will be made by June 1, and will be available from August 1, 1925, to August, 1926.

## THE PORTLAND MEETING OF THE PACIFIC DIVISION

THE 1925 meeting of the Pacific Division of the American Association for the Advancement of Science and its affiliated societies will be held at Reed College, Portland, Ore., from June 17 to 20. The American Association as a whole will join with the Pacific Division in this meeting.

Another summer meeting of the association as a whole will occur jointly with the Southwestern Division, at Boulder, Colorado, from June 9 to 11. The dates for these two summer meetings are so arranged that members may attend both of them, with nearly a week intervening for travel.

The preliminary announcement of the Portland meeting is now in preparation and will be mailed to every member of the American Association about April 30. The Scientific Research Conference will be held at the noon luncheon on Wednesday, June 17. The names of those who will speak at this conference will be announced in due time. On Wednesday evening will be given the presidential address by Dr. C. E. Grunsky, and a public reception will follow.

There will be general sessions on Thursday and

Friday evenings at which popular addresses will be given by distinguished speakers. It is hoped that the president of the American Association for the Advancement of Science, Professor Michael I. Pupin, will be present and will give one of these addresses. A banquet will occur on Thursday evening preceding the public address. Dinners by various affiliated societies will occur on Wednesday and Friday evenings.

It is hoped that a symposium on some subject of broad general interest can be arranged for Thursday afternoon. All the other afternoons and all the forenoons will be available for sessions of the various affiliated societies. Saturday and Sunday will be devoted to excursions, and it is expected that a number will be arranged to several of the near-by points of unusual scenic or scientific interest, such as The Dalles, Mount Hood, Mount Rainier and Multnomah Falls, all of wonderful scenic beauty and interest; the classic John Day River fossil beds which visiting paleontologists will wish to see; the fish hatcheries at Little White-Salmon, Bonneville and Clackamas; the beautiful Hood River Valley with its great apple orchards; Astoria, only a few miles away, the center of the wonderful salmon fisheries of the Columbia and replete with historic interest. A visit is planned to the State Agricultural College at Corvallis and probably to the State University at Eugene.

Those interested in angling will not fail to visit Willamette Falls where they may try their luck with the salmon. Facilities will be provided also for visits to some of the great forests and the great lumber mills.

The prospects for a meeting of unusual size and interest are good. The climate and other conditions are ideal at that season and a more delightful time for a visit to the great Northwest could not be selected. It is expected that many Eastern members and their friends will avail themselves of this exceptional opportunity to visit the Pacific Coast.

Dr. A. A. Knowlton, Reed College, Portland, is the chairman of the local committee on arrangements. Any one desiring further information regarding the meeting may address Dr. Knowlton or the acting secretary, Dr. Barton Warren Evermann, California Academy of Sciences, San Francisco.

## SCIENTIFIC NOTES AND NEWS

THE sixty-first annual meeting of the National Academy of Sciences will be held at the National Academy Building, Washington, D. C., on April 27, 28 and 29.

THE regular spring meeting of the executive committee of the council of the American Association for the Advancement of Science will be held at Washington, on Sunday, April 26. Association business to be brought before the committee should be in the hands of the permanent secretary of the association, Smithsonian Institution Building, Washington, by April 20.

DR. JACOB GOULD SCHURMAN, minister to China, formerly professor of philosophy at Cornell University, and later president, has been appointed by President Coolidge ambassador to Berlin.

RENICK W. DUNLAP, of Ohio, has been nominated by the President to be Assistant Secretary of Agriculture.

THE presentation of the John Fritz Gold Medal, the highest honor bestowed by the engineering profession in the United States, to John Frank Stevens, former chief engineer of the Panama Canal, for great achievements as a civil engineer, particularly in planning and organizing the construction of the Panama Canal; as a builder of railroads, and as administrator of the Chinese Eastern Railway, took place on March 23. The speakers at the ceremony included Ralph Budd, president of the Great Northern Railway Company, and Roland S. Morris, former ambassador to Japan. John R. Freeman, of Providence, R. I., presided.

JOEL D. JUSTIN was recently awarded the James R. Croes Medal by the directors of the American Society of Civil Engineers for his paper on "The design of earth dams."

DUBLIN UNIVERSITY will confer the honorary degree of master of surgery on Dr. George W. Crile, of Cleveland, Ohio, and Dr. Charles H. Mayo, of Rochester, Minn.

THE Laetare Medal, given annually by the University of Nôtre Dame, has been awarded to Dr. Albert Francis Zahm, professor of mechanics, in the Catholic University of Washington, for his work in the field of aerial navigation.

THE University of Edinburgh has awarded the Cameron prize of £200 for distinction in practical therapeutics to Professor R. Magnus, of the Royal University, Utrecht, Holland.

DR. ROUX, director of the Pasteur Institute in Paris, has been elected honorary member of the Institute of Experimental Medicine in Leningrad. Professor W. M. Beijerinck, Holland, and Dr. C. Neuberg, Berlin, have been elected corresponding members.

DR. S. E. STRÖMGREN, director of the University Observatory at Copenhagen, has been elected a member of the Prussian Academy of Sciences.

DR. MAUCLAIRE, surgeon to the hospitals of Paris since 1897, has been elected to the French Academy of

Medicine to take the place of the late Professor Rochard.

PROFESSOR ÉMILE BOREL, of the faculty of sciences of the University of Paris, has been given an honorary doctorate by the University of Copenhagen.

PROFESSOR WILLY WIEN, of Würzburg, has been elected an honorary fellow of the Physical Society of London.

THE Romanes Lecture for 1925 will be delivered by Sir William Bragg in London on May 20 on "The crystalline state."

THE council of the Royal Anthropological Institute of Great Britain has elected Professor Sir William Ridgeway as Huxley lecturer and Huxley medallist for 1926.

DR. CHARLES W. HOLTON, secretary of the College of Pharmacy of Columbia University, has been elected president of the American Pharmaceutical Association. He succeeds Dr. H. V. Arny, professor of chemistry in the College of Pharmacy.

DR. ARTHUR D. LITTLE, president of Arthur D. Little, Inc., of Boston, has been elected to succeed Dr. Charles H. Herty as chairman of the Advisory Committee of the Exposition of Chemical Industries.

PROFESSOR ALEXANDER SILVERMAN, of the University of Pittsburgh, has been elected chairman of the glass division of the American Ceramic Society.

AT the University of London, Professor H. R. Kenwood has been appointed emeritus professor of hygiene, and Sir John Rose Bradford, emeritus professor of medicine.

PROFESSOR HENRY BEDINGER MITCHELL, professor of mathematics at Columbia University, has resigned.

AUGUSTO BONAZZI, for many years in charge of the soil biological investigations of the Ohio Agricultural Experiment Station, has resigned his position to accept the directorship of the Chaparra Sugar Cane Experiment Station in San Manuel (Ote), Cuba.

AT the thirty-fifth annual meeting of the Association of American Medical Colleges which met in Boston, from March 5 to 7, the following officers were elected: Drs. Hugh Cabot, Ann Arbor, *president;* David L. Edsall, Boston, *vice-president;* Fred C. Zapffe, Chicago, *secretary* (reelected); *members of the executive council:* Irving S. Cutter, Omaha; Walter L. Niles, New York, and Charles F. Martin, Montreal. The next meeting will be in Charleston, S. C., from October 26 to 28, 1925.

AT the forty-seventh annual meeting on March 2, of the Institute of Chemistry, London, the following officers for the year ending March, 1926, were elected: *President,* Professor G. G. Henderson; *vice-presidents,* Professor E. C. C. Baly, Mr. E. R. Bolton, Mr. A. Chaston Chapman, Dr. T. Slater Price, Professor A. Smithells, Mr. E. W. Voelcker; *honorary treasurer,* Mr. P. H. Kirkaldy.

AT the annual general meeting of the Physical Society, London, held on February 13, the following officers were elected: *President,* Mr. F. E. Smith; *vice-presidents* (who have filled the office of president), Sir Oliver J. Lodge, Sir Richard Glazebrook, Dr. C. Chree, Professor H. L. Callendar, Sir Arthur Schuster, Sir J. J. Thomson, Professor C. Vernon Boys, Professor C. H. Lees, Sir W. H. Bragg, Dr. Alexander Russell; *vice-presidents,* Dr. E. H. Rayner, Dr. J. H. Vincent, Dr. D. Owen, Mr. C. R. Darling; *secretaries,* Professor A. O. Rankine, Imperial College of Science and Technology; Mr. J. Guild, National Physical Laboratory; *foreign secretary,* Sir Arthur Schuster; *treasurer,* Mr. R. S. Whipple; *librarian,* Mr. J. H. Brinkworth.

DR. JAMES R. WEIR, pathologist in charge of pathological collections, Bureau of Plant Industry, has completed a two-months period of service with the Tropical Plant Research Foundation on a survey of sugar cane fungi in Cuba. Dr. Weir afterwards collected and studied the diseases of tropical plants in Haiti, the Dominican Republic and Puerto Rico.

DR. MEL T. COOK, plant pathologist for the Insular Experiment Station of Porto Rico, spent the first week of March in Santo Domingo on a mission for the Insular Department of Agriculture.

DR. RALPH W. CHENEY, of the museum of paleontology, University of California, is to join the expedition of Roy Chapman Andrews, now moving into the Gobi Desert, in central China.

DR. JOSEPH T. SINGEWALD, professor of economic geology at the Johns Hopkins University, has received leave of absence from the university to explore geological formations in South America.

PROFESSOR T. D. A. COCKERELL, of the University of Colorado, and Mrs. Cockerell, will visit Argentina during the coming summer, to examine two localities for fossil insects which have been discovered near the eastern base of the Andes. Mrs. Cockerell is writing a book on the zoology of Colorado, to be published next year by the University of Colorado.

DR. ALEXANDER PETRUNKEVITCH, professor of zoology at Yale University, has received a year's leave of absence to study zoology in Porto Rico.

DR. O. A. REINKING, pathologist for the United Fruit Company, has gone on a trip to collect banana plants in Formosa, the East Indies, China, Siam and

India. He is making a special study of the insects inhabiting the banana.

DR. BENGT KJERRMAN, of the Ingeniors Vetenskaps Akademien, Stockholm, has come to the United States for one year as a research fellow at the Bureau of Standards, for the purpose of comparing the Swedish and American methods for determination of gases in metals.

DR. H. C. WILLIAMSON, of the Scottish Fisheries Bureau, has been appointed to investigate the salmon of British Columbia at Prince Rupert.

PROFESSOR JOHN J. ABEL, of the Johns Hopkins University, who was chosen by the Association of American Physicians as the lecturer of the Kober Endowment of Georgetown University for 1925, delivered the lecture on March 28 on "Some recent advances in our knowledge of the ductless glands."

AT the annual meeting of the American Institute of Chemists, which will open in Baltimore on April 6, Dr. Charles Munroe, of Washington, will deliver an address on "Organization of chemists in the United States." Dr. James Kendall, professor of chemistry at Columbia University, will speak on "Some notable chemical discoveries."

DR. WILDER D. BANCROFT, professor of physical chemistry at Cornell University, will give a series of three lectures on structural colors at the Wagner Free Institute of Science on March 26, 27 and 28.

DR. M. L. CROSSLEY, president of the American Institute of Chemists, addressed the Washington chapter at its March meeting on the subject, "Chemistry as a profession." Previous to the meeting, resident fellows of the institute tendered a dinner to Dr. Crossley at the Raleigh Hotel.

DR. RICHARD C. CABOT, professor of clinical medicine, Harvard University Medical School, will be the principal speaker at the annual honors convocation at the University of Michigan on April 24.

DR. WHEELER P. DAVEY, of the Research Laboratory of the General Electric Company, gave a series of lectures before the departments of physics and chemistry of Cornell University during the week of March 23. His subject was "Crystal structure and its relation to physics and chemistry."

THE 198th meeting of the Washington Academy of Sciences and affiliated engineering and metallurgical societies was held in the Cosmos Club on Thursday, March 19, when Dr. Karl Benedicks, director, Metallographic Institute, Stockholm, Sweden, delivered an address on "The theory of high-speed steel."

THE *Journal of General Physiology* proposes to issue Volume VIII as a memorial to its founder, Dr. Jacques Loeb. The volume, which will contain papers by Dr. Loeb's pupils and his associates and a portrait and a sketch of his life, will appear simultaneously with Volumes VII and IX, and publication will commence about July 1.

MRS. HERMANN BIGGS has given to the New York Tuberculosis Association funds to establish an annual lectureship on tuberculosis as a memorial to her husband, the late Dr. Hermann M. Biggs.

THE Maine Federation of Agricultural Associations will present to the University of Maine a bronze tablet in memory of Rutillus Alden, who did much for the promotion of agriculture in Maine.

SHIRELY E. ROBERTS, formerly professor of mathematics at the University of the Philippine Islands, died on March 9, aged forty-seven years.

MISS EMMA FRANCIS, assistant professor of agricultural and biological chemistry at the Pennsylvania State College, died on March 4.

DR. A. DE WATTEVILLE, for many years editor of *Brain* and distinguished for his work on the nervous system, died on February 24, aged seventy-eight years.

DR. AUGUST VON WASSERMANN, director of the Kaiser Wilhelm Institute for Medical Research and professor of experimental therapy at the University of Berlin, died on March 16, aged fifty-nine years.

DR. ARTHUR HEFFTER, formerly director of the institute of pharmacology at the University of Berlin, died on February 12 at the age of sixty-six years.

A CORRESPONDENT writes: "The death occurred on March 10 of Dr. William McInnes, Ottawa. Dr. McInnes was appointed to the staff of the Geological Survey of Canada in 1882 and spent several years in the study of the Paleozoic sedimentary formations of New Brunswick. The years 1890 to 1900, inclusive, were spent in mapping the Precambrian formations of western Ontario. During the next ten years he was engaged in exploratory work in the district of Patricia, northern Ontario, and in northern Manitoba and Saskatchewan. The results of his work are set forth in numerous publications of the Geological Survey. He was one of the editors of the three-volume work on the "Coal Resources of the World" and the "Compte-Rendu" of the twelfth International Geological Congress which met in Canada in 1913. In 1915 he was made "directing geologist in charge of all geological and field parties," and in 1919 was created director of the Geological Survey of Canada, the highest position in the gift of the survey. From this post he was transferred in 1920 to the position of director of the Victorian Memorial Museum, and editor-in-chief of the Department of Mines. This

office he held until his death. He was elected fellow of the Geological Society of America in 1889 and fellow of the Royal Society of Canada in 1912."

COLONEL THOMAS L. CASEY, U. S. A., retired, who recently died in Washington, D. C., bequeathed his collection of beetles and his library pertaining to entomology, as well as his collection and library in malacology, to the U. S. National Museum. The beetle collection contains some 15,000 species of which about one third are represented by types.

THROUGH the generosity of Messrs. Watermeyer and Leonhardt, president and vice-president of Fritzsche Brothers, Inc., a research fellowship in the chemistry of perfumes and essential oils has been offered to Columbia University. The fellow is to be appointed by the University Council, upon nomination of a committee of award composed of the president of Fritzsche Brothers and the senior professor of organic chemistry at Columbia, and approved by the department of chemistry. The recipient of the fellowship will receive $3,000 per annum and the investigations will be conducted under the direction of Professor Marston T. Bogert.

THE regular meeting of the American section of the Society of Chemical Industry was held at the Chemists' Club, on March 20, when James G. Vail spoke on "Silicate solutions and some siliceous gels" and Dr. Edward R. Berry spoke on "The manufacturing uses of clear fused quartz and its value in medical fields."

ARRANGEMENTS are being made for the holding of an International Dairying Conference in London in 1926 or 1927. The conference will be supported by the Ministry of Agriculture. According to the London *Times*, the purpose is to stimulate the production of milk by devising new or improved methods and to enhance its consumption by increasing the public appreciation of its value as a food. It is proposed that every interest concerned, not only in the production and distribution of milk, but in its consumption also, should be represented at the conference—cattle-breeding organizations, dairy farmers, landowners, health societies, local authorities and the makers of dairying appliances. A national committee will be formed for the organization of the conference. A similar congress was held in the United States last year and the government contributed £7,000 towards its cost, which was £27,000. The Ministry of Agriculture think that the Treasury might contribute a quarter of the cost of the proposed congress on the basis of a total expenditure of £10,000.

WHAT is said to be the finest engineering laboratory in the country is being completed by the Ford Motor Company, at Dearborn, Michigan, according to *Chemical and Metallurgical Engineering*. It is designed for chemical, metallurgical and affiliated industrial research and experiments, comprising practically one room in a new building, 202 x 804 feet, approximately two city blocks in length. The total glass area of the new laboratory proper aggregates 64,000 square feet, or equivalent to 40 per cent. of the total floor space. The mechanical installation consists of complete equipment for the construction of an entire automobile, with chemical research apparatus, physical test machines, equipment for metallurgical research and investigations, drafting room facilities, etc. No piping or wiring is exposed in the laboratory; all power lines are under the floor in conduits, with feed wires led up through the floor to individual motor drives. The building will also contain a comprehensive reference library.

ACCORDING to *Nature*, at the opening meeting for the 1924–25 session of the Institution of Petroleum Technologists, England, awards of the institution's medals and scholarships were announced. The Boverton Redwood Medal for the sessions 1919–20 and 1920–21 was awarded to M. Paul de Chambrier for his paper on the "Working of petroleum by means of 'shafts' and 'galleries,'" read before the institution on February 15, 1921. This medal, presented to the institution by Mr. Alexander Duckham to commemorate the late Sir Boverton Redwood, founder and first president of the institution, is awarded to the author of the paper of the greatest merit on any subject connected with petroleum technology, presented to the institution during two consecutive sessions, and is not confined to members of the institution. The award has been made retrospective to 1919, the date of Sir Boverton Redwood's death. As there was no paper of outstanding merit for the sessions 1921–22 and 1922–23, no award has been made for those sessions. The Student's Medal and Prize has been awarded to Lieutenant J. H. Blakiston, formerly student of the oil technology course at the University of Birmingham, for his paper entitled "The oilfields of Roumania." This award is made to the student member of the institution who presents the best paper on any subject connected with petroleum technology, in any one session. This is the first award of this medal and prize. A scholarship has been awarded to Mr. Ernest Clark, of the Royal School of Mines. These scholarships are awarded annually, one each to the Royal School of Mines, Imperial College of Science and Technology, London, and to the University of Birmingham, to a third-year student, taking the petroleum technology course, who is also a student member of the institution.

FURTHER plans for the cooperative study of the

physical-chemical properties of Portland cement by the National Bureau of Standards and the Portland Cement Association include the following projects: 1. A study of cement clinker made from pure compounds and from pure compounds with admixture of the impurities found in natural materials. 2. Petrographic studies to determine the optical characteristics of cement mineral constituents and the quantitative petrographic analysis of clinker. 3. A study of the hydration of cement in all its phases. 4. The crystalloidal behavior of silicic acid. Thus far the work has included principally the development, construction and standardization of equipment and methods of testing. It is hoped that the studies can be extended into other fields beyond those already projected. This work will continue and extend the bureau's studies, which for several years have been under the direction of P. H. Bates; Dr. R. H. Bogue, formerly at Lafayette College, will be directly in charge of the association's group of workers who are stationed at the bureau.

## UNIVERSITY AND EDUCATIONAL NOTES

A SIX-STORY building to house teaching and research in the departments of physiology, physiological chemistry and pharmacology is being planned at the University of Chicago as a unit of the group of buildings for medical education which will be erected in the near future. Funds have been provided independently of the university's $17,500,000 development program.

THE Arkansas legislature, which recently adjourned, appropriated $650,000 for new buildings to be erected at the University of Arkansas in the next biennial period.

THREE gifts totaling $360,000, to complete the $5,000,000 endowment fund for Hampton and Tuskegee institutes, have been received by the committee. Edward S. Harkness gave $250,000; Mrs. Stephen V. Harkness, $100,000, and Mrs. E. H. Harriman, $10,000.

GLASGOW TECHNICAL COLLEGE, England, has received the sum of £50,000 from an anonymous donor.

DR. AGNES L. ROGERS, of Smith College, has been appointed professor of education and psychology at Bryn Mawr College.

W. R. HALLIDAY and S. R. Lott, formerly assistant professors in the department of machine design at Stevens Institute of Technology, have been advanced to the rank of associate professors. J. C. Wegle has been made assistant professor in the same department. Professor Wegle has also been appointed acting dean of student activities.

DR. ALFRED P. LATHROP has resigned his position in Queens University, Canada, to accept a position as associate professor of organic chemistry in Oberlin College.

ARTHUR CLARK TERRILL, for the past four years professor of mining engineering at Pei Yang University, Tientsin, China, is now lecturer in geology at the California Institute of Technology.

AT the University of Aberdeen, Dr. A. Bowman has been appointed to the lectureship on the scientific study of fisheries, in succession to Dr. T. Wemyss Fulton, resigned.

## DISCUSSION AND CORRESPONDENCE

### MARKET CHARTS AND THE LAW OF SUPPLY AND DEMAND

IN general when the price of a commodity is lowered the demand for it increases, slightly or considerably, as the case may be. This response of demand to price changes is, of course, vital in all marketing problems. Although not very precise relations between price and demand are known, curves may be drawn showing their general trend and salient characteristics.

Such plotted curves—market charts—may also be drawn showing the production of a given commodity (*e.g.*, automobiles) at each price. This curve, together with the corresponding curve showing demand as a function of price, give a direct relation between supply and demand in mathematical terms as exact as the data from which they are drawn, namely, the slopes of the price-supply and demand-price curves. Finally, areas under the curves are volumes of business, actual or to be expected, as the case may be.

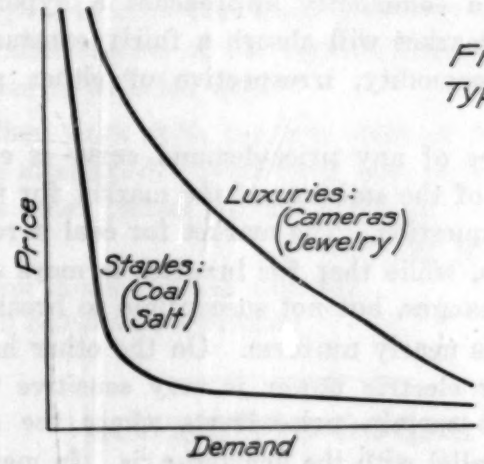


*Fig. 1.*
*Types*

These characteristics are illustrated in the accompanying figures. Fig. 1 shows two extreme types of curves, namely, for staples and for luxuries. The consumption of coal, salt and the like would be very little affected by price. If the price dropped to one

tenth its present value, the consumption would probably not be doubled. On the other hand, every slight decrease in the price of candies, cameras or jewelry is reflected in increased consumption.

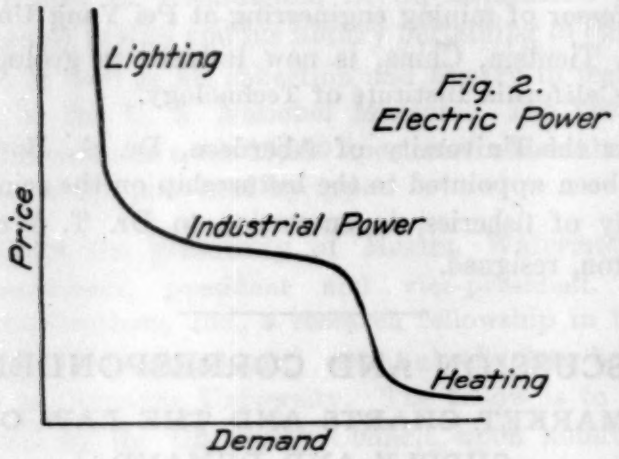


Fig. 2. Electric Power

Many market curves show a pronounced shoulder at certain price levels. Electric power (Fig. 2) is a case in point. The demand for electricity for lighting is not sensitive to price. Electricity for industrial power is in rapidly increasing demand at prices below 5 cents per kw. hr. The electrochemical industries require a still lower rate (0.5 to 2 cents) before extensive use begins. Finally at rates below 1 mill per kw. hr. an almost unlimited demand would arise for electricity for heating. Obviously a small depression in price near a shoulder of the curve would result in a greatly increased volume of business and in profits.

It may be noted that the mathematical form of these curves is roughly that of a hyperbola, $xy =$ constant. Hence if the price is in, say, dollars per pound and the consumption (demand) is in pounds, the product dollars per pound times pounds is dollars, and is roughly constant, independent of both price and demand. It follows, therefore, that if the market chart for a commodity approaches a hyperbola in form, the market will absorb a fairly constant *value* of that commodity, irrespective of either price or demand.

The *slope* of any price-demand curve is evidently a measure of the *stability* of the market for the commodity in question. The market for coal is relatively very stable, while that for luxuries is more sensitive to price changes, but not susceptible to breaks, since the slope is nearly uniform. On the other hand, the market for electric power is very sensitive to price changes at certain price levels where the slope is nearly parallel with the demand axis. In mathematical terms, the derivative of the curve is a measure of the sensitiveness of the market.

Other interesting deductions suggest themselves to one versed in mathematics. For example, let $dD/dC$ represent rate of change in demand with change in cost, *i.e.*, the slope of the demand-cost curve. Let $dC/dS$ be the rate of change of price with supply, then $dD/dS$, the rate of change of demand with supply is the product of the above ratios, $dD/dS = dD/dC \times dC/dS$. This ratio is evidently a measure of the degree of *saturation* of the market. If supply just balances demand the ratio $dD/dS = 1$. At the shoulder of the electric power curve (Fig. 2) $dD/dC$ may be as high as 10. If now the supply-cost curve were smooth, a ratio $dC/dS = 1$ would be reasonable and therefore $dD/dS = 10$. The interpretation of this is evidently that the market for electric power can only be stabilized by making the cost-supply curve similar in form to the cost-demand curve. This is done in practice by establishing higher rates for service involving greater installation and maintenance costs. This note is intended merely to call attention to some simple applications of higher mathematics to market analysis. The viewpoint which it provides is believed to be new and has already proven useful in certain limited fields and may well be of service in other fields.

P. G. NUTTING
WASHINGTON, D. C.

## TWO FATAL CASES OF POTATO POISONING

THE common white potato, *Solanum tuberosum* L., has long been regarded as poisonous, although the toxic principle, the alkaloid *solanin* ($C_{52}H_{93}NO_{18}$) seems to be confined to the green parts of the plant.

Reports of stock losses due to eating either the tops or the tubers that have turned green after exposure to light, are not rare. In one case, 64 cows became ill and exhibited symptoms of poisoning after eating liberal quantities of potato tubers, an Iowa veterinarian reports the poisoning of a cow due to eating potato parings, Chesnut and Wilcox of the United States Department of Agriculture record the loss of six pigs due to eating sprouted, uncooked potatoes, while the writer investigated a case in southern Indiana in which thirty chickens died shortly after eating a large quantity of green potato sprouts. Macfadyen demonstrated that old sprouted potatoes are poisonous to horses.

Reports of human potato poisoning are comparatively rare. According to one account 56 soldiers in Berlin were seriously affected several years ago with potato poisoning, but all recovered when the feeding of the potatoes was stopped. Pammel states in his "Manual of Poisonous Plants" that some persons can not eat potatoes because poisonous to them, and further remarks that the water in which potatoes have been boiled contains a poisonous substance. County Agent Fred I. Hoover of New Albany, Indiana, informed the writer that the illness of a family of five

members in Floyd County, Indiana, was attributed to potato poisoning.

Since there is little specific data available regarding human potato poisoning, an account of two recent deaths after eating greened potatoes may be of interest. About October 15, 1924, James B. Matheney, of Vandalia, Illinois, gathered about one and one half bushels of tubers from a patch of strawed potatoes. The tubers were distinctly green, due to having been exposed to sunlight following the scattering of the straw by chickens. On October 18, the family started to use the greened potatoes and two days later began to show symptoms of poisoning. All members of the family, consisting of father, mother, two daughters and five sons, were ill with the exception of the father, who did not partake of the tubers, and a child of 18 months, who lived on milk almost exclusively. The mother, aged 45, died on October 25, while a daughter, Cynthia, aged 16, died two days later. The other five members of the family recovered.

Altogether, six physicians worked on these cases. Two diagnoses were made, milk sickness and potato poisoning, but the milk sickness theory was eliminated when it was shown that the two heaviest users of milk, the father and 18-months-old child, were not affected, while the mother, who died, never used milk or dairy products, with the exception of an occasional teaspoonful of milk in her coffee and a small amount of butter. Furthermore, the four cows in the pasture exhibited no symptoms of white snakeroot poisoning even after having been violently driven. In addition, the characteristic breath odor of milk sickness was absent. No wild berries, nuts, etc., had been eaten. The evidence seemed clear that the deaths of the mother and daughter were due to potato poisoning as a result of eating greened tubers.

The symptoms were described by Dr. Walter D. Murfin, of Vernon, Illinois, one of the attending physicians, as follows:

> The symptoms of all were nearly the same. The first symptom was epigastric pain, which increased in severity until nausea and vomiting ensued, which began from one to two hours after the pain started. After emesis of the stomach contents and bile, the vomiting ceased and there was but little pain. All were constipated except the fourteen-year-old boy who exhibited mild diarrhoea. There was no fever; the temperature was 97.4 to 98.4. The pulse was normal. The expression was dull, while the patients were apathetic, indifferent and extremely exhausted. Two were restless before exhaustion began. One was extremely thirsty, the others did not crave water. The respirations were extremely difficult and accelerated but not of the Cheyne-Stokes type. No particular odor to the breath. Weakness and prostration were marked. Consciousness was retained by the two who died until within three or four hours of death. No convulsions. Examination of the chest, abdomen and reflexes was negative.

These symptoms agree in several particulars with the symptoms described in the case of 56 Berlin soldiers previously mentioned. Briefly, these symptoms were headache, colic, nausea, diarrhoea, general debility, vomiting and acute gastro-enteritis. The majority were drowsy and apathetic. Several victims fainted and a number showed rise in temperature to 103° F.

ALBERT A. HANSEN
PURDUE UNIVERSITY

## SO-CALLED SALMON POISONING OF DOGS

THE question of whether or not salmon is the cause of a disease of dogs is an old one in the Pacific northwest. The findings in studies now in progress are considered of sufficient importance to be reported.

A number of dogs developed typical symptoms and died after eating "sore-back" salmon. This is a popular term which applies to the mature fish that are found in fresh water streams during the spawning season. The spawned salmon undergo tissue degeneration which results in discoloration of the skin. They die after reaching fresh water.

Salmon which was caught in salt water was fed to dogs. No symptoms developed in these dogs.

A small trematode has been found in the intestinal tracts of dogs that died after eating "sore-back" salmon. Large numbers of these parasites and their eggs have been found accompanied by a severe inflammation of the intestines. This trematode is a fluke, but has not yet been identified.

Microscopic cysts have been found in the muscles of the "sore-back" salmon used in this experiment. It is logical to infer that these cysts may be one of the intermediate forms of the mature fluke found in the intestines of affected dogs.

Further work with the life cycle of this parasite will be attempted. Work will also be continued on various other phases of this problem.

C. R. DONHAM
OREGON AGRICULTURAL COLLEGE
AND EXPERIMENT STATION

## SCIENTIFIC BOOKS

*An Introduction to the Theory of Optics.* BY SCHUSTER AND NICHOLSON. *A Treatise on Light.* BY R. A. HOUSTOUN, 2nd edition.

A PERUSAL of these two books is highly educational, not only because of the store of information they

contain, but also because of questions which are suggested by comparison of their respective contents and method of treatment. What, for instance, should a book whose title is "Light" or "Optics" be reasonably expected to include within its scope? Or, stating the question from another angle, is an author entirely fair to his reader when, under a general title such as "Optics," he really writes about "Those topics in optics which interest me"?

The question of what to include in modern optics is a difficult one to answer, because optics, considered in the light of the fields of knowledge it has opened up to us, has become one of the most comprehensive of the sciences. Taking its start in the study of the phenomena of unaided vision, it became later a study of the means of aiding and extending vision. One branch of optics thus initiated was physiological optics, which has led the searcher after knowledge into the most abstruse problems of photochemistry, neurology and psychology. The earlier means of increasing the scope of the eye were mirrors and lenses, which led to the study of optical instruments and geometrical optics. Optical instruments as exemplified in the telescope and microscope have led us on the one hand to the bounds of the universe and on the other to the most minute forms of life. In studying the manner in which the eye is stimulated, we have investigated the nature of light and have thereby learned that visible radiation is only a small part of an enormously extended spectrum, reaching now from X-rays at one extreme to wireless waves at the other. In analyzing the method of transmission of radiant energy, we have been led to the hypothesis of the ether and so to speculations on the relation of matter to ether. Testing these by the most refined methods of optical analysis, as in the famous Michelson-Morley experiment, we have been driven to the theory of relativity, which threatens to revolutionize our ideas of the form of the universe. Analysis of the composition of emitted radiation, through spectroscopy, has led us to conceptions of the ultimate structure of matter and of radiation, formulated in the quantum theory, which are at the present time the most vital in the whole realm of physics. It is obvious from this superficial statement of the fields included under the general title of "Optics" that not only is there a real problem before the author of a book with such a title, but it is also probably after all humanly impossible for any one man to take all optics as his province.

A really informative account of the two books under review must start with a statement of what each contains, because the authors have quite different ideas as to what it is incumbent on them to treat. Schuster and Nicholson do not include under optics any phase of physiological optics. The only discussion of the eye is in connection with its behavior as a lens, namely, its resolving power. Color and color vision are not recognized as optics. Geometrical optics appears only in a highly generalized form. The elementary laws of reflection and refraction and the properties of lenses and mirrors lie, one learns by casual mention, outside the scope of this volume. On the other hand, the book is exceptionally full in its treatment of such branches of optics as are related to mechanics. Practically every problem is introduced as a problem in mechanics, the optical bearing of the discussion appearing often as a rather minor conclusion. It is thus characteristic of the book that it opens with a discussion of periodic motion (altogether excellent) and that it is not until 22 pages have been read and the second chapter entered that the word "light" is found at all, and then only as illustrative of a point in wave propagation. The practical methods for the measurement of light we find do not lie within the range of this treatise on optics, but the measurement of earth tides does.

Readers should be cautioned against the section entitled "Photometry." The statement that the difficulties of heterochromatic photometry have been "solved" by Merton and Nicholson will startle workers in photometry. As a matter of fact, in entire consistency with their policy of ignoring physiological optics, the photometry the authors have in mind is really radiometry. The difficulty caused by unequal sensitiveness of the radiometer at different wave lengths—the only one they recognize—is probably the least troublesome problem encountered by the photometrist when facing a color difference.

Schuster and Nicholson's book is noteworthy for a very full discussion of theories of light. This discussion, while most interesting, leaves one with the impression that there is a conflict still going on between the elastic solid and the electromagnetic theory. It is undoubtedly of interest to learn how near the elastic solid theory came to success, and there may be a pedagogical reason for introducing practically every optical problem as one of the problems of an elastic solid, but the interest is now largely historical. The battle ground to-day has shifted to the question of wave theory *vs.* quantum theory.

The most extensive new section in the book is that dealing with emission spectra and the quantum theory, which is handled in a very thorough manner as a problem in atomic structure and dynamics. One may, however, again raise the question as to what is appropriate to a work on optics. The development

of spectroscopy has made optics a powerful tool in the study of atomic structure, and it is undoubtedly fitting that some treatment of this subject should appear in a work on optics. Ought we not, however, to expect at least some discussion of the questions as to the nature of light raised by the quantum theory? What of the photoelectric effect (not mentioned) and of the difficulty of reconciling quantum phenomena of light emission and absorption with the wave theory which so much of the book is occupied in expounding? Here is a neglected opportunity, one may even say duty, for any one attempting to set forth the theory of optics. The authors fall clearly in that group of physicists who have been described as using the wave theory Monday and Wednesday and the quantum theory Tuesday and Friday.

Dr. Houstoun's book is very different from the volume of Schuster and Nicholson, to which in many ways it is complementary. There can be no doubt that the author's primary interest is in optical phenomena. "Light" is the first word of the text. He devotes considerable attention to the eye and to physiological optics. His treatment is much better calculated to appeal to students who are "eye-minded" than is the treatment found in the other book under review. Usually each optical phenomenon is described before its theory is discussed, and the theory is apt to be illustrated by diagrams which aid in understanding it. In the discussion of the laws of radiation, for instance, Houstoun describes the experimental black body and shows energy distribution curves of emission for various temperatures, while Schuster and Nicholson give several pages of mathematics, leading to the Planck formula, with the statement that the formula is well established. The first treatment is calculated to arouse interest in the physics of radiation. Can as much be said for the second?

The "Treatise on Light" is a new edition. It takes over from the first edition a full and well-written treatment of elementary geometrical optics and a clear and well-balanced presentation of the general divisions of physical optics. It contains much interesting material on the instruments and experimental methods of optics and takes up practical developments, such as artificial lighting. It is to be highly recommended as a text-book, in so far as its earlier portions go.

As a revised edition, the book is decidedly disappointing. One can not avoid the impression that the author's contact with and interest in his subject have waned. Revising that should have been done has been neglected, and the treatment of new developments is not satisfactory. What is the value of a "revised" section on spectral series which does not include the Bohr theory? One gathers that Dr. Houstoun is a skeptic on quantum theory, but its place in spectroscopy is too well established to excuse its utter ignoring. Other examples of unsatisfactory revisions are to be noted, among them several which one would not expect from a worker who has contributed as much in the realm of photometry and color vision as has Dr. Houstoun. The opening statement of the section on photometry that "a point source of light radiates equally in all directions" is quite wrong, unless Dr. Houstoun is trying to develop a new system of photometric definitions. A point source is simply one whose dimensions are small relative to the distances with which we work in measuring or using it. The crater of the carbon arc is one of the best examples of a point source and one of the most unsymmetrical in its light distribution. The statement on page 346 "by combining each positive with *the filter through which the corresponding negative* was taken . . . a picture is obtained on the screen of the original object in its natural colors" is one of which Dr. Houstoun should certainly not have been guilty.

The reviewer finds that in the effort to tell what these books contain, he has harped chiefly on what they lack. While it is true that they both leave some of the most important phases of modern optics inadequately treated, they do nevertheless contain a very large part of all that most students of optics may reasonably expect to get from text-books. Dr. Houstoun's book is one of the best introductions to optics available, and will carry many students as far as they need go in the subject. Schuster and Nicholson's book is for rather advanced workers in optics whose interest has been roused in special topics. For them it contains a wealth of material, not to be found elsewhere, which no one working in optics can afford to be without—for example, the treatment of such topics as the pulse theory of radiation and the theory of spectroscopic instruments.

It is a real service for leaders in a subject to bring together in book form the substance of their most important contributions, presented in proper relationship to what has been done before. It is probable that both these books after all gain more from the reflections they give of the views of their authors on their special lines of work than they suffer by neglect of certain fields. The modern student of optics, if he intends to be up-to-date on his subject, must expect to browse among many books and to read the periodicals of physical science as assiduously as the newspapers.

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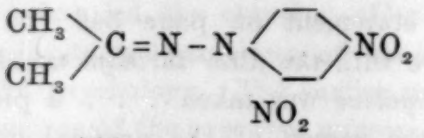
# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## A NEW METHOD OF DETECTING AND ESTIMATING SMALL AMOUNTS OF ACETONE

AT the recent meeting of the "Medizinischnaturwissenschaftliche Gesellschaft," of the University of Tübingen, Professor Carl Bülow described a new method of detecting and estimating quantitatively small amounts of acetone in urine. The method is based upon the earlier observations of Purgotti[1] and Theodor Curtius,[2] that in boiling alcoholic solutions certain aldehydes and ketones form condensation products with 2.4 dinitro-phenyl-hydrazine. The new product thus obtained with acetone, namely, acetone 2.4 dinitro-phenyl-hydrazon, is quite insoluble in cold water. Its formula is



and its mol. wt. 238.

In the course of a series of researches on monochloracetone and other substituted ketones, Professor Bülow found that the reaction between acetone and dinitro-phenyl-hydrazine goes to completion, even in the cold, in a ten per cent. aqueous solution of muriatic acid. A yellowish, milky precipitate is formed which rapidly changes to fine needle-like crystals, that can readily be filtered off, washed, dried and weighed. These needles are insoluble in hot water as well as in fifty per cent. alcohol. They are consequently washed with hot water, then with alcohol, and finally dried and weighed. 238 grams of the product correspond to 58 grams of acetone.

Bülow's new "acetone reagent" is prepared by dissolving 0.33 grams of 2.4 dinitro-phenyl-hydrazine in 250 cc. alcohol, adding 10 cc. of 10 per cent. hydrochloric acid and heating till the product has completely dissolved.

The test is made by acidifying 10 cc. of urine with 1 cc. of hydrochloric acid, and then adding the "acetone reagent" in sufficient quantity. If the urine contains more than 0.5 per cent. of acetone, a yellowish, milky precipitate forms in a few seconds. By this very simple means every physician can in a short time determine with certainty whether acetone is present or not. Bülow, who is preparing a paper describing the test in greater detail, claims that 0.03 per cent. of acetone may still be estimated quantitatively by this method. It is at his request that I am presenting this report to the readers of SCIENCE at this time.

UNIVERSITY OF WISCONSIN LOUIS KAHLENBERG

1 *Gazetta Chimica Italiana*, 1893.

2 *Jour. prakt. Chem.*, 50, 257.

# SPECIAL ARTICLES

## MERCURY AND IONIZED HELIUM

Two investigators have recently made preliminary reports that under certain conditions of electrical discharge gaseous helium becomes capable of entering into chemical combination. According to J. J. Manley,[1] mercury and helium, in the presence of electric glow discharge, combine with contraction of volume to form a stable gaseous mercury helide which must be raised to a bright red heat in order to decompose it and to restore the original volume. On the other hand, E. H. Boomer,[2] while finding evidence that helium under electronic bombardment forms solid compounds with mercury, iodine, sulphur and phosphorus, which are stable at low temperature, reports that on allowing the temperature to rise from that of liquid air, the helides of sulphur and phosphorus decompose sharply at $-125°$ C., and those of iodine and mercury at $-70°$ C.

Since in both cases the activation of helium was supposed to take place under conditions where its ionization might be expected, it was interesting to see if combination could be detected with another mode of ionization. We have been engaged in the study of various chemical reactions under the ionizing influence of radon, and therefore were led to carry out the following experiment.

An elongated spherical glass bulb of 5.5 $cm^3$ volume was carefully evacuated at elevated temperature to 0.0001 mm pressure by means of a mercury vapor pump. Then 191 milli-curies of radon were introduced, at an initial pressure of 0.2 mm which did not change by more than 0.1 mm over a period of 5 hours, as determined by means of a mercury manometer separated from the reaction chamber by a fine capillary to avoid contact with mercury. Having thus established that no gas was evolved from the walls under the alpha-ray bombardment, mercury was run into the vessel up to a mark, so as to occupy approximately one fourth of its volume and to present a surface of about 3 $cm^2$. Over a period of 22 hours the pressure remained constant within 0.1 mm of mercury, establishing a blank for the vessel containing radon in contact with mercury. The mercury was then withdrawn and 614.1 mm of helium were introduced, which had been purified by passing repeatedly through active charcoal at liquid air temperature, until the nitrogen bands had entirely disappeared. Action of radon on this helium produced no change in pressure of as much as 0.1 mm in 22 hours.

Mercury was then again introduced to the previous

1 *Nature*, 114, 861 (December 13, 1924).

2 *Nature*, 115, 16 (January 3, 1925).

mark and no change of pressure resulted of more than 0.3 mm mercury in 47 hours. The entire chamber with contents was then immersed in liquid air, the pressure was determined and temperature measurement (accurate to 0.03° C.) was made with a platinum resistance thermometer. After 22 hours the temperature and pressure were again determined and no change of pressure exceeding 0.2 mm was found to have taken place, leading to the conclusion that under alpha-ray bombardment no disappearance of helium had resulted. In the great majority of reactions that we have studied the ratio (M/N) of the number of molecules reacting to the number of ion pairs generated is of the order from 1 to 6. Since for a value of M/N equal to unity, the pressure of helium would have decreased by 50 mm in this experiment, there is no evidence of the formation of a helium compound. This negative result with α-particles does not prove that helium and mercury do not interact under electrical discharge, since electron bombardment frequently produces chemically active resonance states, which are not known to be produced by alpha-particles.

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## THE NATIVE HOST OF THE CHIGGER

WITHIN the past few years several acarologists have undertaken investigations hoping to answer the question of the native host of our common chigger, named by Dr. H. E. Ewing "The Mexican chigger-mite."[1] Among other studies of the Acarina undertaken by the author was an investigation of the above problem. The results have been most encouraging and seem to have settled this matter, at least in part.

Professor C. V. Riley and many of his students believed that the chiggers fed on various plant juices. Some larval Trombidiidae were then discovered on insects and the conclusion was drawn that all were parasitic on tracheates. During his studies Dr. Ewing came into the possession of a specimen of King snake, *Lampropeltis getulus getulus,* infested with the chigger that attacks man. While prosecuting this study the snake molted and all the mites were cast with the skin. None were reared to maturity, and the conclusion was drawn that the snake did not serve as a natural host. In a short article appearing in SCIENCE[2] during the past year Dr. Ewing reports as follows: "That he has found the hitherto unknown full-grown form of the common chigger, together with strong indications that the rabbit is largely responsible for its spread. The adult chigger has been known to entomologists as Trombicula . . ."

A few years ago several specimens of black snakes, *Zamenis constrictor,* were captured that had small red parasitic mites attached to the skin between the scales. Not having any particular interest in the Acarina at this time the specimens were allowed to escape without further study.

During the summer of 1923 several black snakes, *Zamenis constrictor,* and garter snakes, *Eutoenia sirtalis,* of various sizes were captured that also carried the small red mites between the scales. Specimens were removed, mounted and determined as *Trombicula tlalzahuatl* Murray. These determinations were later confirmed by Dr. Ewing. The hosts were confined and fed, but none of the mites had reached maturity when it was necessary to discontinue the observations.

During the season of 1924 large and small specimens of the black snake, *Zamenis constrictor,* the garter snake, *Eutoenia sirtalis,* the common hog-nosed snake, *Heterodon platyrhinus,* the black hog-nosed snake, *Heterodon platyrhinus niger,* and the eastern ring-necked snake, *Diadophis punctatus,* were captured carrying countless numbers of chiggers. These hosts were taken throughout southern Ohio. Copperheads, rattlesnakes and water snakes, although examined alive, were never found to be infested with the chiggers. The infested snakes were confined in suitable aquaria and fed on newts, toads and frogs. Due to the molting of several of the snakes their parasites were lost, as had been the experience of Dr. Ewing. Observations were made daily, but at no time did any of the snakes appear annoyed by the presence of the numerous parasites. Engorgement was very slow. When engorged to repletion the bright red body protruded beyond the margin of the overlapping scale and was easily seen. After an infested snake has fed and the scales are widely separated due to the engorged condition of the body the parasites, apparently standing on their heads, are very conspicuous. No mites have been found attached beneath the ventral scales or beneath the close set scales of the head.

Throughout late September the engorged larvae, which have been in this condition for several weeks, begin to fall from the host and make their way by very sluggish movements into the loose soil to a depth of from one half inch to an inch. The length of time between apparent engorgement and detachment from the host may be necessary to allow extrication of the mouthparts. From two to three weeks is spent in a quiescent stage similar to the pupal stage of many insects after which the adult emerges, but from all

[1] "The chigger mites affecting man and the domestic animals," H. E. Ewing and A. Hartzell, *Jour. Ec. Ent.,* 2, 2, 1918, p. 261.

[2] "Life history of chigger," H. E. Ewing, SCIENCE—Supplement, 2, LIX, 1924, p. xiv.

observations thus far made does not appear above ground, nor have they been found to leave their earthen cells until the following spring.

Following the usual biology of the Trombidiidae oviposition does not take place until the following spring. There is but one generation a year. The very moist conditions held by some authors to be necessary for development have not been verified by the work thus far performed. Some adults have been reared under very dry conditions while others from the same host have reached maturity under quite moist surroundings.

Further details and additional studies on *Trombicula tlalzahuatl* Murray will appear at a later date.

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# THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

## SOCIETIES RELATED TO SECTION O (AGRICULTURE) AT WASHINGTON

*(A report for Section O appeared in Science for February 6.)*

### *The American Society of Agronomy*

*President,* C. W. Warburton.

*Secretary,* P. E. Brown, Iowa State College, Ames, Iowa.

*(Report by P. E. Brown)*

The society held a joint program with Section O as shown in the report of the section, and also participated in the agricultural dinner. No separate meeting of the society was held.

### *The American Society for Horticultural Science*

*President,* M. J. Dorsey.

*Secretary,* C. P. Close, U. S. Department of Agriculture, Washington, D. C.

*(Report by C. P. Close)*

The American Society for Horticultural Science held its annual meeting on December 29, 30 and 31. The program was so crowded that it was necessary to divide into sections on two half days, making eight sessions in all. There was one joint session with Section O of the American Association for the Advancement of Science, at which the teaching of horticultural courses and methods of experimentation were especially considered. A session was devoted to extension work in horticulture, in which methods and results of this work were discussed. There was one session on vegetable topics and another on fruit topics. The other sessions were general, covering both fruits and vegetables. The attendance was the largest in the history of the society, about 100 members being present.

### *The Society of American Foresters*

*President,* Walter Mulford.

*Secretary,* R. V. Reynolds, U. S. Forest Service, Washington, D. C.

*(Report by R. V. Reynolds)*

The twenty-fourth annual meeting of the society was held on December 30 and 31, in the spacious library of Central High School, allotted them through the efficient management of the A. A. A. S. At the close of the first quarter century of the society's existence the program presented a review of the development of forestry in the United States, a sober estimate of the present standing and achievements of the profession, and a forward glance at ways and means for future accomplishment adapted to American needs. A dozen leading speakers covered some of the principal subjects in the wide field of forestry, while others commented briefly and amplified the ideas of the principals.

The attendance probably constituted the largest assemblage of professional foresters ever convened in the United States, including federal and state officials, foresters in private and corporate employ, and the leading educators from the foremost forestry schools. The registered attendance was 182, including six of the eight fellows, 112 seniors, 26 members, six associates, and 32 guests. The members present represented 12 of the 14 sections composing the society and came from 23 states, the District of Columbia and Canada. The membership has tripled since 1917, and now amounts to 1,094 members, in six grades.

The executive council transacted a large amount of business before the annual meeting. It was voted to employ an executive secretary on part time, as a preliminary step to an eventual increase of dues and a full-time secretary. The council is unanimous in considering that this move is essential. The *Journal of Forestry,* previously issued eight times yearly, will become a monthly in 1925. A standing Committee on International Relations in Forestry was established.

One of the most enjoyable events of the meeting period was a smoker held at the Cosmos Club on the evening of December 30, at which all visiting and local foresters were guests of the Washington Section of the society and an entertainment committee organized by the United States Forest Service. Over 200 men attended, heard short addresses and music, watched motion pictures related to forestry and con-

servation, sang the songs of undergraduate days and consumed vast quantities of refreshments and tobacco. Here the comradeships of camp and field were renewed. Old friends met after years of separation and new attachments were formed. The annual meeting of 1924 will not soon be forgotten by those who attended.

### *The Potato Association of America*

*President,* A. G. Tolaas.

*Secretary-treasurer,* Wm. Stuart, U. S. Department of Agriculture, Washington, D. C.

(*Report by Wm. Stuart*)

The eleventh annual meeting of the Potato Association, which was held Monday, Tuesday and Wednesday of convocation week, proved to be one of the most satisfactory ever held. A membership increase of over 90 per cent. during the year 1924 was reported. The report of the research committee included a summary of the year's literature, chiefly with respect to pathological investigations. Seed certification standards employed in 1924 were summarized by states and provinces in the report of the "Seed improvement and certification committee." The symposiums on "Seed-potato improvement," "Rest period and storage of potatoes" and "Potato spraying and dusting" proved very valuable. Two resolutions were adopted. The first urged the United States Department of Agriculture to make and publish all practicable investigations on the production and marketing of this and past potato crops, in order that both producers and consumers may utilize the 1924 potato crop to the best advantage of all, and also urged upon farmers the use of poor-quality potatoes as feed for livestock when the low price of potatoes renders such use more profitable than that of grain for feeding. The second resolution expressed the appreciation of the association for the many courtesies extended to it by the American Association for the Advancement of Science and the local committees for the Washington meeting.

### *The Association of Official Seed Analysts*

*President,* Miss Anna M. Lute.

*Secretary,* A. L. Stone, University of Wisconsin, Madison, Wis.

(*Report by A. L. Stone*)

The Official Seed Analysts held six well-attended sessions, three of which were executive, extending from Wednesday to Friday, inclusive. The papers given covered many subjects of vital interest to the members, including possible improvements in technique and methods of seed analysis. One afternoon was partly devoted to a visit to the seed testing laboratory of the United States Department of Agriculture, where various methods of making purity and germination tests were demonstrated. Special problems of seed analysis and germination were discussed and special methods for their solution were recommended. The members then proceeded to the general exhibition of the American Association for the Advancement of Science, which proved very interesting and instructive. The outstanding feature of the meeting was Retiring President Munn's report on the meeting of the International Seed Testing Congress held in London July, 1924. He gave a short résumé of each of the important papers presented at the congress and described his visits to several European seed laboratories. Attention was drawn to the very great difference in the status of seed laboratories in North America and in Europe. Some of the latter have very large buildings and trial grounds, with as many as thirty permanent employees, the work of these laboratories being an indispensable and extremely important feature of the agricultural program in Europe. It was pointed out that the seed laboratories in this country are not supported in a manner commensurate with the value of their services to the agriculture of the nation. The annual address of the retiring president, Professor M. T. Munn, was delivered at the annual dinner on Thursday evening. It was an able and earnest discussion of the problems and opportunities confronting seed analysts.

Friday forenoon was devoted to a round-table discussion of topics of vital interest to the work of the association. At this session the association voted unanimously to become a member of the International Seed Testing Association. The open sessions of the meeting were attended by a number of commercial seed analysts and by representatives of seed houses who showed great interest in the proceedings. It was a very successful meeting.

### *The Geneticists Interested in Agriculture*

*Secretary ad interim,* Sewall Wright, U. S. Department of Agriculture, Washington, D. C.

The fifth annual meeting of the geneticists interested in agriculture was held jointly with Section O of the American Association for the Advancement of Science on Monday, December 29, with about 70 in attendance. The topic for discussion was "Plant and animal judging in relation to genetics." Dr. John W. Gowen, of the Maine Agricultural Experiment Station, presented a paper on judging of dairy cattle. He discussed the correlation between various